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(71) Applicant: **Martinazzi, Angelo**
20094 Corsico (Milano) (IT)(72) Inventor: **Martinazzi, Angelo**
20094 Corsico (Milano) (IT)(74) Representative: **Mittler, Enrico**
c/o Mittler & C. s.r.l.,
Viale Lombardia 20
20131 Milano (IT)(54) **A system of sound diffusion, particularly for large spaces**

(57) A system of sound diffusion comprises a device (1) for the central amplification of a source signal (Vin) for generating an amplified signal, at least one device (2) for transducing the amplified signal into a sound signal and a respective line (22) with two wires (23, 24) for the transmission of the amplified signal from the central amplification device (1) to the transducer device (2). The transducer device (2) comprises local amplification means (30) for amplifying the amplified signal received from the central amplification device for driving a loudspeaker (38). The central amplification device (1) comprises first magnetic-induction coupling means (17) for the coupling of the amplified signal to the transmission line (22) and generating means (3) for generating a direct-current voltage (V1) supplied to the transmission line (22) so that on the transmission line (22) there is present a signal variable over time induced by the amplified signal superimposed over the direct-current voltage (V1). The transducer device (2) comprises second magnetic-induction coupling means (25) for separating the signal variable over time present on the transmission line (22) from the direct-current voltage (V1), the latter supplying the local amplification means (30) and the signal variable over time being amplified by the local amplification means (30) for driving the loudspeaker (38).

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Description

The present invention relates to a system of sound diffusion, particularly for large spaces.

In the field of sound and voice diffusion in large spaces such as meeting rooms, churches, etc., systems made with analog technology are known that have a central wide-band amplifier that amplifies a source signal, for example a pre-amplified signal originating in a microphone, and a plurality of loudspeakers distributed in the space in question. Each loudspeaker, in addition to comprising an electro-acoustical transducer, also has a local amplifier that amplifies the signal from the central amplifier bringing it to a level suitable for driving the electro-acoustical transducer.

The connection of each loudspeaker to the central amplifier thus requires at least two pairs of wires, a first pair for the wide-band amplified signal, and a second pair to supply the local amplifiers with the necessary voltage. This involves fairly high installation costs.

Systems are also known made in digital technology using analog/digital (A/D) and digital/analog (D/A) converters that for the connection of each loudspeaker to the central amplifier require only one pair of wires. These systems, however, are very expensive.

In view of the state of the art described, an object of the present invention is that of providing a system of sound diffusion that, while still made in analog technology, requires only one pair of wires for the connection of each loudspeaker to the central amplifier, that has a low production cost and that is simple to assemble and to install.

According to the present invention, the abovementioned objects are attained thanks to a system of sound diffusion comprising a device for the central amplification of a source signal an amplified signal, at least one device for transducing said amplified signal into a sound signal and a respective line with two wires for the transmission of said amplified signal from the central amplification device to the transducer device, said at least one transducer device comprising local amplification means for amplifying said amplified signal received from the central amplification device for driving at least one loudspeaker, characterized in that said central amplification device comprises first magnetic-induction coupling means for the coupling of said amplified signal to said transmission line and generating means for generating a direct-current voltage supplied to said transmission line so that on said transmission line there is present a signal variable over time induced by said amplified signal superimposed over said direct-current voltage, and in that said transducer device comprises second magnetic-induction coupling means for separating said signal variable over time present on the transmission line from said direct-current voltage, said direct-current voltage supplying said local amplification means and said signal variable over time being amplified by said local amplification means for driving said at least one loudspeaker.

Thanks to the present invention, it is possible to provide a system of sound diffusion in analog technology that requires only one pair of wires for the connection of a central amplification device to a peripheral electro-acoustical transducer device, on said pair of wires it being possible to send both the sound signal and a supply voltage of a local amplifier of the peripheral transducer device.

These and other features and advantages of the present invention will be made more evident by the following detailed description of an embodiment thereof, illustrated as a non-limiting example in the only enclosed figure, that shows a circuit diagram of a system of sound diffusion according to the present invention.

With reference to the only figure, there is shown therein a system of sound diffusion according to the present invention.

The system comprises a transmitter transducer 1 and a plurality (two in the example of the figure) of receiver transducers 2.

The transmitter transducer 1 comprises a stabilized power unit 3 that, starting from the mains alternating-current voltage (220 VAC) generates at output, across a positive terminal 8 and a negative terminal 9, a stabilized direct-current voltage V1 of about 24 VDC, whose value can, however, be regulated from the outside for the reasons that will be explained later. The positive terminal 8 of the power unit 3 is connected to an input terminal VI of a voltage regulator 4 with three terminals (known in itself) that, between an output terminal VO and a reference voltage GND of the entire circuit represented by the potential of the negative terminal 9 of the power unit 3, supplies a regulated direct-current voltage V2 of about 18 VDC. The third terminal of the regulator 4 is connected to the reference voltage of the circuit. Condensers C1 and C2, with typical values of 2200 μ F and 1000 μ F, respectively, are connected between the input terminal VI of the regulator 4 and the reference voltage GND, and between the output terminal VO of the regulator 4 and the reference voltage GND, respectively; the condensers C1 and C2 perform in a known manner filtering functions of the input and output voltages of the regulator 4.

In parallel with the power unit 3 there is also connected a 24-volt buffer battery 6, that cuts in to supply the circuit if the line alternating-current voltage were to drop off; a diode 7 connected in series between the positive terminal of the battery 6 and the positive terminal 8 of the power unit 3 insulates the battery 6 from the rest of the circuit when the voltage V1 is above about 23.5 VDC.

The voltage V2 supplies a power amplifier 5, for example of the type commercially identified by TDA1905. The amplifier 5 has an invertent terminal 10 and non-invertent terminal 11; the invertent terminal 10 is connected to the reference voltage GND and to a first signal input terminal 12 of the transmitter transducer 1; the non-invertent terminal 11 is connected, through a

condenser C3 (for example with a value of 22 μ F) and a potentiometer R1 (for example with a value of 220 ohms), to a second signal input terminal 13 of the transmitter transducer 1. Across the terminals 13 and 12 there is applied a low-voltage pre-amplified input signal Vin (typically of a few milliwatts).

An output terminal 14 of the amplifier 5 is connected, through three coupling condensers C4, C5 and C6 that in this embodiment have values of 1000 μ F, 2200 μ F and 2200 μ F, respectively, to a terminal 15 of a primary winding 16 of a line-coupling transformer 17, the other terminal 18 of the primary winding 16 being connected to the positive output terminal 8 of the power unit 3. Between the common terminal of the condensers C5 and C6 and the reference voltage GND there is connected a resistance R2 that, with the condensers C5 and C6, acts as a high-pass filter for the amplified signal at output from the amplifier 5. A secondary winding 19 of the transformer 17 has a terminal 20 connected, in common with the terminal 18 of the primary 16, to the positive output terminal 8 of the power unit 3. A tap 21 whose position of insertion can be varied along the secondary winding 19 is coupled in feedback, by means of a condenser C7 of 0.18 μ F, to the common terminal of the condensers C4 and C5. The secondary winding 19 of the transformer 17 is wound so as to have phase inversion between the signal on the primary winding 16 and the signal induced on the secondary winding 19.

The transmitter transducer 1 is connected to each of the receiver transducers 2 by means of a respective transmission line 22 with two wires, consisting of normal electrical conductors. A first wire 23 of the line 22 is connected to a central point 24 of the secondary winding 19 of the transformer 17; a second wire 24 of the line 22 is connected to the reference voltage GND.

The receiver transducers 2 comprise a transformer 25 having a primary winding 26 with a first terminal 27 connected to the wire 23 of the line 22, and thus to the central point 24 of the secondary winding 19 of the transformer 17 in the transmitter transducer 1, and a second terminal 28 coupled, by means of a condenser C8 of 2200 μ F, to the wire 24 of the line 22, and thus to the reference voltage GND. The terminal 28 of the primary winding 26 of the transformer 25 is connected to an input terminal VI of a voltage regulator 29 with three terminals identical to the regulator 4 of the transmitter transducer 1 and that supplies, on an output terminal VO, a regulated voltage V3 of about 18 volts that supplies an amplifier 30, for example identical to the amplifier 5 of the transmitter transducer 1. A third terminal of the regulator 29 is connected to the terminal of the condenser C8 connected to the wire 24, that is to the reference voltage GND. There is also provided a condenser C9 of 1000 μ F connected between the output terminal VO of the regulator 29 and the reference voltage GND. The condensers C8 and C9 perform functions substantially similar to those performed by the condensers C1 and C2 of the transmitter transducer 1, in addition the condenser C8 allows the signal to be closed again

toward the reference voltage GND.

The transformer 25 also has a secondary winding 32, wound in phase opposition to the primary winding. A first terminal 31 of the secondary winding 32 of the transformer 25 is connected to the terminal 28 of the primary winding 26. A second terminal 33 of the secondary winding 32 is coupled, by means of two condensers C10 and C11 for example of 1000 μ F, a potentiometer R3 and a condenser C12 for example of 22 μ F, to a non-invertent input 34 of the amplifier 30; between the common terminal of the condensers C10 and C11 and the reference voltage GND there is connected a resistance R4, for example of 47 kohms, that acts as an impedance adaptor. A central point 35 of the secondary winding 32 is also coupled, by means of a condenser C13 for example of 0.18 μ F, the potentiometer R3 and the condenser C12, to the non-invertent input 34 of the amplifier 30; the central point 35 is also connected, by means of a resistor R5 for example of 10 kohms, to the terminal 31 of the secondary winding 32. The invertent input 36 of the amplifier 30 is connected to the reference voltage GND, and an output terminal 37 of the amplifier 30 drives, through a condenser C14, a loudspeaker (or a set of loudspeakers) 38.

The system of sound diffusion described previously operates in the following manner.

The stabilized power unit 3 generates, starting from the alternating-current mains voltage (typically 220 VAC) a stabilized voltage V1 of about 24 volts; the output voltage V1 of the power unit 3 can be regulated (increased) from the outside so as to compensate for the drop in voltage along the line 22 due to the resistance of the wires 23 and 24; moreover, the amp rating of the power unit 3 depends on the total number of receiver transducers that the transmitter transducer 1 has for driving, that is on the total direct current that flows along the line 22. The voltage V1 is taken by the regulator 4 to the regulated voltage V2 of about 18 volts necessary to supply the power amplifier 5 so that the latter can provide an output power of about 4 watts. To the latter there is applied at input the source signal Vin to be amplified, signal having an amplitude of the order of a few mW that is for example generated by any microphone pre-amplifier with output equal to 0 dBm. The output signal of the amplifier 5 is applied, after being filtered, to the terminal 15 of the primary winding 16 of the transformer 17; to the other terminal 18 of the primary winding 16 there is also applied the direct-current voltage V1, so that on the primary winding 16 of the transformer 17, between the terminals 18 and 15, there is present a signal in alternating current (the signal at output of the amplifier 5) superimposed on a direct-current component (the voltage V1). On the secondary winding 19 of the transformer 17 there is induced a signal in phase opposition with respect to the signal present on the primary winding, added to a signal in phase with the signal present on the primary winding (and thus in phase opposition with respect to the signal induced on the secondary winding) carried directly on the second-

ary winding by means of the condenser C7; this signal determines a levelling-off of the total signal present on the secondary winding 19 of the transformer 17. Since one terminal of the secondary winding 19 is also connected to the output terminal 8 of the power unit 3, between the wires 23 and 24 of the line 22 there is present a signal in alternating current corresponding to the abovementioned total signal present on the secondary winding, superimposed on a direct-current component equal to the voltage V1 (24 volts).

In the receiver transducer 2, the primary winding 26 of the corresponding transformer 25 acts as a block impedance that separates the direct-current component present on the transmission line 22 of the signal. The direct-current component, that is seen again across the condenser C8, is taken to a regulated voltage of 18 volts by the regulator 29, a voltage that is necessary to supply the amplifier 30 so as to allow an amplification of about 4 watts. The alternating-current signal present on the line 22 is on the other hand induced, in phase opposition and raised in voltage with a ratio of about 1 to 2, in the secondary winding 33; from the secondary winding 33 there are taken, on the terminal 33 and on the point 35, two signals that are coupled by means of the condensers C10, C11 and C13, respectively, to the input of the amplifier 30; the condensers C10 and C11 form part of a low-pass filter, while the condenser C13 forms part of a high-pass filter. The total signal present at the input of the amplifier thus consists of two in-phase signals in separate frequency bands and delayed one with respect to the other due to their different take-off points on the secondary winding. Said total signal is amplified by the amplifier 30, that drives the loudspeaker 38.

Thanks to the fact that the signal on the secondary winding 32 of the transformer 25 is in phase-opposition with respect to the signal on the primary winding 26, a substantial reduction of the Larsen effect on voice signals is obtained, and a slight environment effect on the musical signals.

It should be noted that as the length of the line 22 increases the capacitance between the wire 23 and the wire 24 (kept at the reference voltage GND) increases; to compensate for such an increase of the capacitance and to avoid the reduction in the band of the transmitted signal, it is possible to move upward the point of connection of the point 21 on the secondary winding 19 of the transformer 17.

The system according to the present invention can also be used for the diffusion of high-fidelity stereophonic sound, as well as in high-powered audio systems.

Claims

1. A system of sound diffusion comprising a device (1) for the central amplification of a source signal (Vin) for generating an amplified signal, at least one device (2) for transducing said amplified signal into a sound signal and a respective line (22) with two

wires (23, 24) for the transmission of said amplified signal from the central amplification device (1) to the transducer device (2), said at least one transducer device (2) comprising local amplification means (30) for amplifying said amplified signal received from the central amplification device for driving at least one loudspeaker (38), characterized in that said central amplification device (1) comprises first magnetic-induction coupling means (17) for the coupling of said amplified signal to said transmission line (22) and generating means (3) for generating a direct-current voltage (V1) supplied to said transmission line (22) so that on said transmission line (22) there is present a signal variable over time induced by said amplified signal superimposed over said direct-current voltage (V1), and in that said transducer device (2) comprises second magnetic-induction coupling means (25) for separating said signal variable over time present on the transmission line (22) from said direct-current voltage (V1), said direct-current voltage (V1) supplying said local amplification means (30) and said signal variable over time being amplified by said local amplification means (30) for driving said at least one loudspeaker (38).

2. A system according to claim 1, characterized in that said first magnetic-induction coupling means (17) comprise a first transformer (17) having a primary winding (16) and a secondary winding (19) wound in phase opposition with respect to the primary winding (16), the primary winding (16) having a first terminal (15) supplied by said amplified signal and a second terminal (18) supplied by said direct-current voltage (V1), the secondary winding (19) having a first terminal (20) supplied by said direct-current voltage (V1), a second terminal (24) connected to a first wire (23) of the two wires (23, 24) of said transmission line (22), and a third terminal (21) coupled capacitatively to said amplified signal.
3. A system according to claim 2, characterized in that said third terminal (21) of the secondary winding (19) of the first transformer (17) is a point having a position variable along said secondary winding (19).
4. A system according to claim 3, characterized in that said generating means (3) for generating a direct-current voltage (V1) comprise a stabilized power unit (3) for generating said direct-current voltage (V1) starting from a mains alternating-current voltage, said central amplification device (1) also comprising first voltage-regulation means (4) supplied from said direct-current voltage (V1) for generating a regulated direct-current voltage (V2) suitable for supplying an amplifier (5) that receives at input said source signal (Vin) and that generates at output (14) said amplified signal.

5. A system according to claim 4, characterized in that the output (14) of said amplifier (5) is coupled to said first terminal (15) of the primary winding (16) of said first transformer (17) by means of filtering means (C4-C6, R2), and the output (14) of said amplifier (5) is coupled to said third terminal (21) of the secondary winding (19) of said first transformer by means of condenser means (C4, C7). 5
6. A system according to claim 5, characterized in that said second magnetic-induction coupling means (25) comprise a second transformer (25) having a primary winding (26) and a secondary winding (32) wound in phase opposition with respect to the primary winding (26), the primary winding (26) having a first terminal (27) connected to said first wire (23) of the transmission line and a second terminal (28) coupled capacitatively to a second wire (24) of said transmission line (22) that is connected to a reference voltage (GND), the secondary winding (32) having a first terminal (31) connected to the second terminal (28) of the primary winding (26), a second terminal (33) coupled by low-pass filtering means (C10, C11) to an input of said local amplification means (30), and a third terminal (35) coupled by means of high-pass filtering means (C13) to said input of the local amplification means (30). 10 15 20 25
7. A system according to claim 5, characterized in that said transducer device (2) comprises second voltage regulating means (29) supplied by said direct-current voltage (V1) for generating a regulated direct-current voltage (V3) suitable for supplying said local amplification means (30). 30 35

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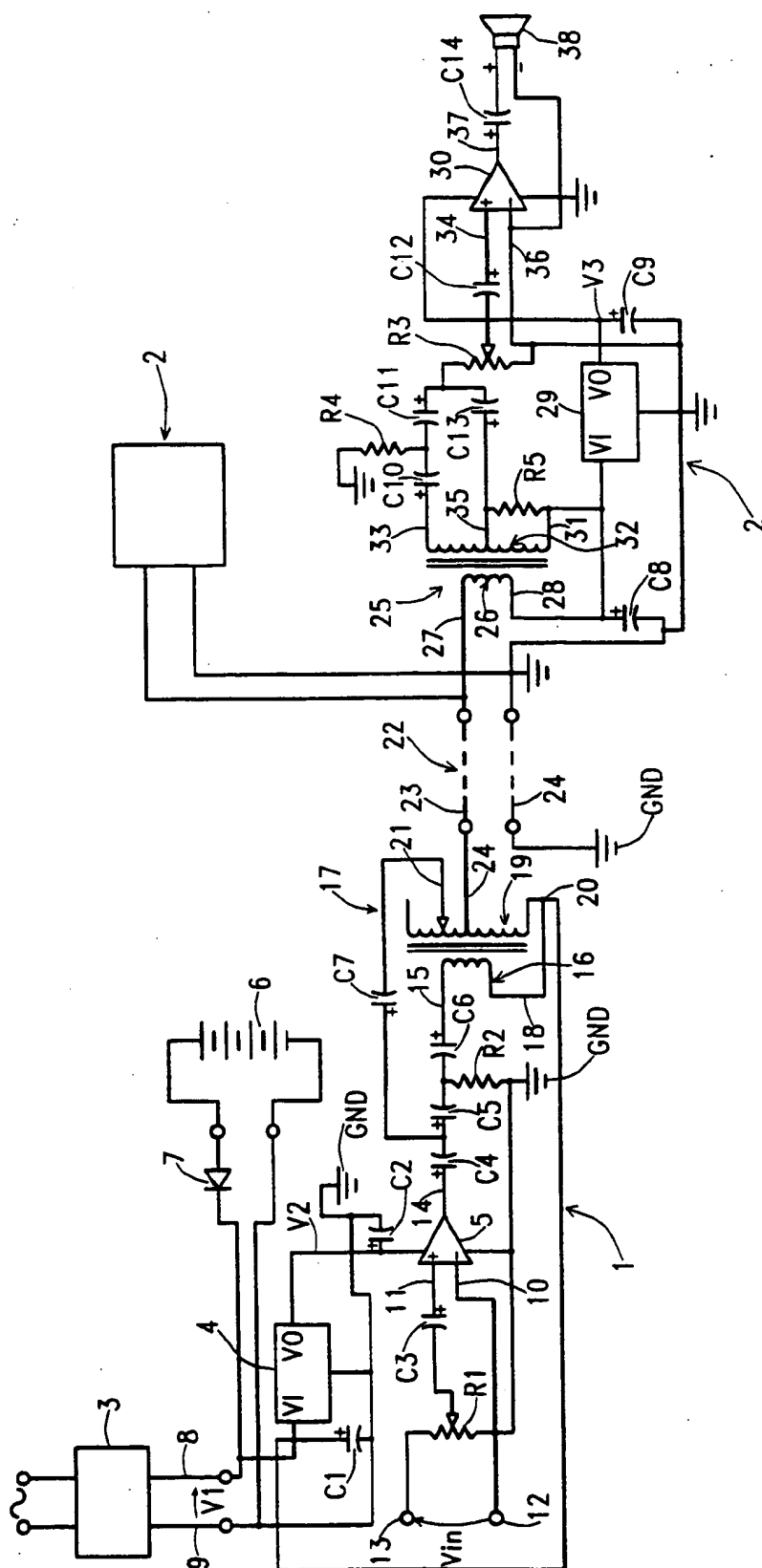
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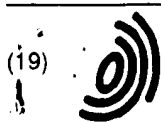
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(72) Inventor: **Martinazzi, Angelo**
20094 Corsico (Milano) (IT)

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(74) Representative: **Mittler, Enrico**
c/o Mittler & C. s.r.l.,
Viale Lombardia, 20
20131 Milano (IT)

(71) Applicant: **Martinazzi, Angelo**
20094 Corsico (Milano) (IT)

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the coupling of the amplified signal to the transmission line (22) and generating means (3) for generating a direct-current voltage (V_1) supplied to the transmission line (22) so that on the transmission line (22) there is present a signal variable over time induced by the amplified signal superimposed over the direct-current voltage (V_1). The transducer device (2) comprises second magnetic-induction coupling means (25) for separating the signal variable over time present on the transmission line (22) from the direct-current voltage (V_1), the latter supplying the local amplification means (30) and the signal variable over time being amplified by the local amplification means (30) for driving the loudspeaker (38).

